Remarks

The Applicant has not cancelled any claims, and has added new dependent Claims 13 and 14. Therefore Claims 1, 2, 4, 6, 7 and 9–14 are currently pending in this application. Claims 1, 6 and 11 are independent.

Claim Rejections Under 35 U.S.C. § 103(a) (Kang + Nogues + Duraiswami)

The Examiner has rejected Claims 1, 2, 4, 6, 7 and 9–12 under 35 U.S.C. § 103(a) as being obvious based on U.S. Patent 5,650,129 ("Kang") in view of U.S. Patent 5,076,980 ("Nogues") and U.S. Patent 6,616,873 ("Duraiswami"). Kang discloses a method of heat treating silica gel particles that includes heating the particles at 2°C min^{-1} in a crucible (see Kang at 3:1–7). Nogues discloses a method of heat treating a sol-gel monolith that includes casting the monolith into a mold and then heating it at 8.3°C min^{-1} (see Nogues at 2:36–54 and 6:45–46). Duraiswami discloses heat treatment of oven dried spheres of talc, clay, alumina and magnesia in a rotary kiln (see Duraiswami at 4:66–5:13 and Table 1).

Claims 1, 2, 4 and 10–12

First, there is no reason that an ordinarily-skilled artisan would modify the Kang teaching of a 2°C min^{-1} temperature gradient to instead use the Nogues teaching of a 8.3°C min^{-1} temperature gradient.

Independent Claim 1 recites a method for fabricating a porous silica sphere that includes, among other things, "heat-treating a plurality of silica gel pellets by increasing their temperature at a speed of 5 to 90°C per minute". Independent Claim 11 recites a method that includes, among other things, performing a heat-treatment on a plurality of silica gel pellets, wherein the heat treatment includes a temperature increasing stage during which "the silica gel pellets are heated at between about 5°C min^{-1} and about 70°C min^{-1}". Acknowledging that neither Kang nor Duraiswami disclose this feature, the Examiner suggests that it would have been obvious to an ordinarily-skilled artisan to modify the Kang 2°C min^{-1} temperature gradient to instead used the Nogues 8.3°C min^{-1} temperature gradient.

There is no reason that an ordinarily-skilled artisan would modify the Kang teachings in this way. The prior art can be modified to reject claims as *prima facie* obvious only if there is a reasonable expectation of success in doing so (see MPEP 2143.02(I)). The Examiner argues that the Nogues 8.3°C min^{-1} temperature gradient is "a known alternative leading to substantially the same result of heat treating the silica gel". But the fact is that the Nogues heat treatment is **not** a "known alternative" to the Kang heat treatment. The two heat treatments are applied to **different materials**, in completely **different contexts** and for completely **different purposes**.

For example, the Kang heat treatment is applied to small silica gel particles having Na_2O, $A\ell_2O_3$ and Fe_2O_3 impurities (see Kang at 3:1–7). In contrast, the Nogues heat treatment is applied to large sol-gel monoliths made from a mixture of an oxide precursor (such as tetramethoxysilane), a catalyst (such as nitric acid) and water (see Nogues at 2:55–56 and 3:60–62). Given these different materials, an ordinarily-skilled artisan would not expect the relatively fast temperature gradient used in the Nogues heat treatment to be a "known alternative" to the much slower temperature gradient used in the Kang heat treatment.

Furthermore, Kang is concerned with heat treating silica gel particles having a size over 10 mesh (see Kang at 3:1–7), while Nogues is concerned with heat treatment of a large sol-gel monolith that has been cast into a mold (see Nogues at 1:66–2:17; casting step (b) precedes densification step (f)). An ordinarily-skilled artisan would not reasonably expect that the Nogues heat treatment for a molded monolith could successfully be applied to small silica gel particles. This is yet another reason that the Nogues heat treatment is not a "known alternative" to the Kang heat treatment.

Finally, the purpose of the Kang heat treatment is to achieve silica balls having a porous internal structure surrounded by a dense outside layer that is not porous (see Kang at 1:43–47). In contrast, the Nogues heat treatment is performed as part of a densification step that produces either (a) a fully densified and nonporous monolith (see Nogues at 7:36–38) or (b) a partially densified monolith having a porous surface (see Nogues at 7:50–56). In either case, the finished monolith disclosed in Nogues is substantially different from the small silica balls having a porous internal structure surrounded by a dense, nonporous outside layer as disclosed in Kang. An ordinarily-skilled artisan would not reasonably expect that the Nogues heat treatment could be applied to achieve the particular end product that the Kang heat treatment is intended to produce.

Therefore, because the Kang and Nogues heat treatments are applied to different materials, in completely different contexts and for completely different purposes, an ordinarily-skilled artisan would not consider these heat treatments to be "known alternatives". As a result, this rationale cannot be used to support the Examiner's suggested *prima facie* case of obviousness.

Second, modifying the Kang teaching of heat treating using a stationary crucible to instead use the Duraiswami teaching of heat treating using a rotary kiln would actually result in silica balls with <u>suboptimal</u> physical properties.

Independent Claim 1 recites a method for fabricating a porous silica sphere that includes, among other things, a heat-treatment that "is performed in a rotary tube furnace". Independent Claim 11 recites a method that includes, among other things, performing a heat-treatment on a plurality of silica gel pellets, wherein "the heat-treatment is performed in a rotary tube furnace". Acknowledging that neither Kang nor Nogues disclose this feature, the Examiner suggests that it would have been obvious to an ordinarily-skilled artisan to modify the Kang crucible to instead use the Duraiswami rotary kiln.

There is no reason why an ordinarily-skilled artisan would modify the Kang teachings in this way. The prior art can be modified to reject claims as *prima facie* obvious only if there is a reasonable expectation of success in doing so (see MPEP 2143.02(I)). The Examiner argues that using the Duraiswami rotary kiln would allow the "physical properties of the resulting spheres" to be optimized. But the fact is that replacing the crucible that Kang discloses with the Duraiswami rotary kiln would cause the silica gel particles to "over-foam" and thus have **<u>suboptimal</u>** physical properties. An ordinarily-skilled artisan would therefore never replace the Kang crucible with a rotary kiln such as that disclosed in Duraiswami.

To verify that the Examiner's suggested modification of Kang would result in an end product with suboptimal physical properties, submitted herewith is a Declaration Under 37 C.F.R. § 1.132 ("the 2010 Kim Declaration"). The 2010 Kim Declaration details the results of an experiment wherein the Kang heat treatment was conducted using a rotary kiln instead of a crucible. Specifically, in this experiment, silica gel particles the same as those that Kang discloses were put into a rotary furnace at heated at 3°C min^{-1}. Kang discloses a temperature gradient of 2°C min^{-1} (see Kang at 3:1–7), but the Applicant may compare the claimed invention with prior art that is **more** closely related to the invention than the prior art relied upon by the examiner (see MPEP 716.02(e)(I)). After heating, baking and cooling the silica gel particles, scanning electron microscope images showing the microstructure of the end product of this process were generated. These images reveal that modifying the Kang heat treatment to instead use a rotary kiln instead of a crucible result in an end product that has a low density and a non-uniform internal microstructure. The resulting product is said to be "over-foamed". Details of the conditions under which this experiment was conducted, as well as a representative scanning electron microscope image of the microstructure of the end product, are provided in Paragraphs 8 and 9 of the 2010 Kim Declaration.

Based on the foregoing, the Examiner's assertion that modifying the Kang heat treatment to instead use the rotary tube furnace of Duraiswami does **not** have "the benefit of optimizing physical properties of the resulting spheres". This rationale therefore cannot be used to support the Examiner's suggested *prima facie* case of obviousness.

Third, the claimed methods produce unexpectedly improved properties which are not present in the cited art.

The Applicant previously submitted evidence that the methods disclosed in Kang result in a silica gel that is either over-foamed and clumped together, or that fails to foam entirely. These inconsistent results are caused by the combination of (a) using of a heating crucible and (b) heating the gel at or below 2°C min^{-1}. This evidence was submitted on 26 June 2009 as part of a Declaration Under 37 C.F.R. § 1.132 ("the 2009 Kim Declaration").

The Examiner discounted the evidence submitted in the 2009 Kim Declaration, stating that it was "not reasonably commensurate in scope with the claimed invention because the experiments were not conducted in a rotary tube furnace. The Applicant has addressed this concern with the submission herewith of the 2010 Kim Declaration. As noted previously, the 2010 Kim Declaration shows that inferior products still result when the Kang heat treatment is conducted using a rotary kiln instead of a crucible.

The Examiner also discounted the 2009 Kim Declaration because "no experiments are provided using the claimed heating rates to show any differences with Kang". Included in the 2010 Kim Declaration that is submitted herewith are the results of experiments wherein silica gel particles were put into a rotary furnace at heated at 20 °C min^{-1}. After heating, baking and cooling the silica gel particles, scanning electron microscope images showing the microstructure of the end products of these processes were generated. These images reveal substantial differences with both (a) the Kang process, as detailed in the 2009 Kim Declaration, as well as (b) the Kang process using a rotary furnace, as detailed in the 2010 Kim Declaration. Specifically, these images show a relatively high density and uniform microstructure; these unexpectedly superior properties cannot be achieved using the Kang process, even if that process is modified to use a rotary furnace. Instead, these unexpectedly superior features are a direct result of using the unique combination of features of the claimed invention. See Paragraphs 10–12 of the 2010 Kim Declaration.

Although evidence of unexpected results must compare the claimed invention with the closest prior art, the Applicant is **<u>not</u>** required to compare the claimed invention with subject matter that does not exist in the prior art. Specifically, requiring the Applicant to compare results of the claimed invention with results of the combination of references suggested by the Examiner in rejecting the claims would be requiring comparison of the results of the invention with the results of the invention. See MPEP 716.02(e)(III).

In conclusion, the Examiner has not established a *prima facie* case of obviousness for the suggested modification of the Kang heat treatment based the teachings of Nogues and Duraiswami. First, there is no reason that an ordinarily-skilled artisan would modify the Kang teaching of a 2°C min^{-1} temperature gradient to instead use the Nogues teaching of a 8.3°C min^{-1} temperature gradient. Second, modifying the Kang teaching of heat treating using a stationary crucible to instead use the Duraiswami teaching of heat treating using a rotary kiln would actually result in silica balls with **suboptimal** physical properties. And finally, the claimed methods produce unexpectedly improved properties which are not present in the cited art.

The Applicant therefore respectfully submits that independent Claims 1 and 11 are allowable over the combined teachings of Kang, Nogues and Duraiswami, and respectfully requests that these rejections be withdrawn. In addition, because Claims 2, 4 and 10 depend from independent Claim 1, and more specifically define the claimed invention, the Applicant respectfully submits that Claims 2, 4 and 10 are allowable over the combined teachings of Kang, Nogues and Duraiswami for at least the same reasons that independent Claim 1 is allowable.

The Applicant has amended dependent Claim 10 to recite that "the temperature is maintained until the porous silica sphere has a filling density between about 0.18 g mL^{-1} and about 0.30 g mL^{-1}". Thus, the claimed property is now recited as a positive, active step rather than a result of the claimed method.

Because Claim 12 depends from independent Claim 11, and more specifically defines the claimed invention, the Applicant respectfully submits that Claim 12 is allowable over the combined teachings of Kang, Nogues and Duraiswami for at least the same reasons that independent Claim 11 is allowable. The Applicant therefore respectfully requests that the rejection of dependent Claims 2, 4, 10 and 12 based on the combined teachings of Kang, Nogues and Duraiswami be withdrawn as well.

Claims 6, 7 and 9

Independent Claim 6 recites a method for fabricating a porous silica sphere that includes, among other things, a first heat-treatment wherein "the temperature in a first rotary tube furnace is increased at an average speed of 35 to 70°C per minute". Acknowledging that none of the cited references disclose this feature, the Examiner asserts that Nogues "teaches that average temperature elevating speed of heat-treating" is a result-effective variable because "it may be altered in order to optimize densification of the gel".

The Applicant respectfully submits that the Examiner has mischaracterized the teachings of Nogues. Nogues discloses a method of performing a densification step on a sol-gel monolith by heating it at 8.3℃ min^{-1} (see Nogues at 2:36–54 and 7:16–21). In this context, what Nogues actually states is that the densification step "may be carried for a period of time and under temperatures to produce either partially densified or fully densified sol-gel monoliths" (see Nogues at 6:61–63).

A simple statement that densification is carried "for a period of time and under temperatures" to produce some result does not constitute recognition that **elevating speed of temperature**—that is, a change in temperature per unit time—is a result-effective variable. Nogues does not specifically recognize this time change in temperature as achieving a recognized result. Likewise, the fact that Nogues discloses several examples using different heat treatments also does not constitute a recognition that elevating speed of temperature is a result-effective variable. Significantly, in the Nogues examples that the Examiner refers to, **several** different experimental parameters were changed. It therefore cannot be said that the elevating speed of temperature during the densification step is uniquely recognized as a result-effective variable.

Based on the foregoing, it is clear that Nogues does not specifically recognize elevating speed of temperature as a result-effective variable. A particular parameter must first be recognized as a result-effective variable before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation (see MPEP 2144.05(II)(B)). Because Nogues does not make such a recognition, it would not have been obvious to modify the teachings of Nogues to obtain the claimed invention. The disclosures of Kang and Duraiswami cannot remedy the shortcomings of Nogues. The Applicant therefore respectfully submits that independent Claim 6 is allowable over the combined teachings of Kang, Nogues and Duraiswami, and respectfully requests that this rejection be withdrawn. In addition, because Claims 7 and 9 depend from independent Claim 6, and more specifically define the claimed invention, the Applicant respectfully submits that Claims 7 and 9 are allowable over the combined teachings of Kang, Nogues and Duraiswami for at least the same reasons that independent Claim 6 is allowable. The Applicant therefore respectfully requests that he rejection of Claims 7 and 9 based on Kang, Nogues and Duraiswami be withdrawn as well.

New Claims 13 and 14

The Applicant has added new Claim 13, which depends from independent Claim 11. New Claim 13 recites that "during the temperature increasing stage the silica gel pellets are heated at between about 10℃ min^{-1} and about 70℃ min^{-1}". This feature was fully disclosed in the originally-filed application disclosure; see, for example, page 4, lines 8–12 of the specification as filed. The Applicant has also added new Claim 14, which depends from independent Claim 6. New Claim 14 recites that "the silica gel pellets have pores with a size between about 20 Å and about 70 Å, and a pore volume between about 0.3 mL g^{-1} and about 1.1 mL g^{-1}". This feature was fully disclosed in the originally-filed application disclosure; see, for example, originally filed Claim 2. It would not be obvious to combine the teachings of Kang, Nogues and Duraiswami to obtain the inventions recited in new Claims 13 and 14 for the reasons expounded herein.

No Disclaimers or Disavowals

Although this communication may include amendments to the application, and may characterize the claim scope and/or referenced art, the Applicant does not concede that previously pending claims are not patentable over the cited references. Rather, any amendments and/or characterizations are being made to facilitate expeditious prosecution of this application. The Applicant reserves the right to later pursue any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. Accordingly, reviewers of this or any parent, child or related prosecution history cannot reasonably infer that the Applicant has made any disclaimers or disavowals of any subject matter supported by the present disclosure.

<u>Conclusion</u>

In view of the foregoing, this application is believed to be in condition for allowance, and such allowance is respectfully requested. Should the Examiner believe that a telephone conference or personal interview would facilitate resolution of any remaining matters, the Examiner may contact the Applicant's attorney at the number given below.

The Commissioner is authorized (a) to charge LEXYOUME's Deposit Account No. 504054 for any fees required under 37 C.F.R. §§ 1.16 and 1.17 that are not covered, in whole or in part, by a credit card payment form submitted herewith, and (b) to credit any overpayment to said Deposit Account No. 504054.

Respectfully submitted,

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